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VARIATIONS OF GLACIERS. V.¹

THE following is a summary of the fourth annual report of the International Committee on Glaciers:²

RECORD OF GLACIERS FOR 1898

Swiss Alps.—Of the seventy glaciers which were measured in 1898, twelve are advancing, fifty-five retreating and the others doubtful.³

Eastern Alps.—The variations reported last year on the Gliederferner and Vernagtferner are confirmed by further measures. The swelling of these glaciers continues to advance down the valley and to carry with it an increased velocity of motion. When it reaches the end of the glacier there will be an advance of the ice. The majority of the glaciers are retreating, though a few of them are advancing. On the whole the tendency to retreat seems to be increasing.⁴

Italian Alps.—The glaciers of Mount Disgrazia, and those of the south side of the Bernina group are all retreating at the rate of several meters a year.⁵

Scandinavian Alps.—The glaciers of Sweden so far as observed show insignificant changes. They are probably stationary. The velocity of the Stuurajekna near its end was found to be about twice as rapid in summer as the annual average.⁶

Polar Regions.—In 1898, the large glacier between Mt. Hedgehog and South Cape, Spitzbergen, was found to project several kilometers into the sea. This glacier is not shown on former maps, and it is therefore possible that it has recently made a great advance.⁷

¹ The first four articles of this series appeared in this JOURNAL, Vol. III, pp. 278–288; Vol. V, pp. 378–383; Vol. VI, pp. 473–476, and Vol. VII, pp. 217–225.

² Archives des Sciences Phys. et Nat., Vol. VIII, pp. 85–115.

³ Report of Professor Forel.

⁴ Report of Professor Finsterwalder.

⁶ Report of Dr. Svenonius.

⁵ Report of Professor Marinelli.

⁷ Report of Dr. Nathorst.

Greenland.—Steenstrup and Drygalski have both concluded from their observations, that the great cold of winter greatly reduces the velocity of motion of the smaller glaciers, but that the large glaciers, nourished by the inland ice, are very little affected by the seasons. Drygalski has found a velocity of twenty meters per day in the great Karajak glacier. The Asakak glacier on the Nugsuak Peninsula has been observed at intervals for fifty years. It retreated nearly a kilometer between 1849 and 1879, and has since then advanced even more. The Sermiarsut glacier no longer reaches tide water as it formerly did, but the other small glaciers of this region show no marked changes. The Blase Dale glaciers on the island of Disco, have continued to retreat since the visit of Professor Chamberlin in 1894.¹

Canada.—The Upper Bow glacier is slowly advancing, but it has not yet reached the extent indicated by former moraines. Freshfield glacier was advancing in 1897, plowing up the débris in front. Stutfield glacier has been covered with débris by great avalanches, and the melting has thus been retarded. As a result the ice is advancing down the valley and is now in the midst of the forest. It is at least a half mile beyond its former limits. The Illecellewaet glacier has retreated 100 to 150 meters since 1888, and probably 200 meters within the present century.

Himalaya.—The Tarsching glacier apparently retreated between 1850 and 1870, at which latter date it was advancing. It seems to be advancing at present and may block up the valley above it, and cause inundations as it has done before.

Africa.—Dr. Hans Meyer visited the cone of Kibo, the highest point of Kilimanjaro, in 1898 and described the extent of its glaciers. The summit is about 6000 meters high, and the ice streams down on all sides. On the northern and eastern sides the winds are dry, and the glaciers only descend a few hundred meters; whereas on the southern and southwestern sides, the winds are moist and one glacier descends as much as 2000 meters from the summit. There has been a distinct retreat since Dr. Meyer's visit in 1889. Dr. Meyer has also discovered

¹ Report of Dr. Steenstrup.

traces of a glacial period on Kilimanjaro, which confirms similar observations of Gregory further north on Kenia.¹

Caucasus.—The glaciers in the neighborhood of Mt. Elbruz are retreating at the rate of eight or ten meters a year, with the exception of the Adyl, which has advanced six or seven meters between 1897 and 1898.²

REPORT ON THE GLACIERS OF THE UNITED STATES FOR 1899³

Montana.—Sperry glacier, discovered a few years ago, is retreating—(*L. B. Sperry*).

Mt. Adams, Wash.—This volcanic peak, like the others of this region, has a number of glaciers streaming down its sides. The White Salmon and the Mazama, respectively, on the southwestern and southern slopes of the mountain, are broad and comparatively short masses of ice. Each divides into two tongues. The White Salmon is largely covered with débris, while the surface of the Mazama is clean to its ends, though it has a large lateral moraine. The causes of these differences do not appear.

On the eastern side of the mountain are the Klickitat and Rusk glaciers, both of which lie in deep canyons. They are two or three miles long, the latter being the shorter. The Klickitat is connected with the ice-cap of the mountain through three couloirs, and is also nourished by ice avalanches which fall down the great precipice which characterizes the eastern side of the mountain. The Rusk derives all its material from avalanches. Neither are free of moraines. The other slopes of the mountain are not cut into ravines and the glaciers on the northern side, probably four in number, are not very distinctly separated from each other; they are also thoroughly covered with débris, so that they could not be readily distinguished from a distance.

The Klickitat glacier was retreating in 1890 (*C. E. Rusk*), but no information is available regarding the variations of the others.⁴

¹ Report of Mr. Norman Collie.

² Report of Mr. Mouchketow.

³ A synopsis of his report will appear in the Fifth Annual Report of the International Committee. The report on the glaciers of the United States for 1898 was given in this JOURNAL, Vol. VII, pp. 221–225.

⁴ The account of these glaciers is taken from descriptions by Professor W. D. Lyman and Mr. C. E. Rusk in the Mazama Magazine, Vol. I, and from a special communication from Mr. Rusk.

Mt. St. Helens.—A glacier on the north side of this mountain was advancing and destroying trees in 1895 (*C. E. Rusk*).

Mount Ranier.—The Nisqually glacier has retreated not less than 100 meters since 1894 (*E. T. Allen*).

Alaska.—Last summer, Mr. E. H. Harrington of New York, invited a number of scientific men to accompany him on a voyage along the Alaskan coast. The full results of the expedition are to be published by the Washington Academy of Sciences.

Twenty-two tide-water glaciers were examined and marks left near many of them by which future changes may be measured.

Photographs and observations made by several members of the expedition show that all the glaciers visited are now retreating except the Crillon glacier on the west side of Mt. Crillon. This glacier does not reach tide-water; it is advancing against the forest and destroying the trees.

Prince William Sound.—Mr. Gannett mapped the glaciers and found that they are all retreating. The Harvard and Yale glaciers have retreated nine miles in a century.¹

The Columbia glacier is now retreating, but the disturbed ground in front of it shows that it has recently advanced. The young trees growing on this disturbed surface place the date of the advance eight or nine years ago. The Muir glacier made an advance about the same time (*G. K. Gilbert*).

Glacier Bay.—All the glaciers seem to be retreating. In 1879, the three glaciers at the head of the bay were united and three or four miles in advance of their present positions. The Charpentier and Hugh Miller also formed one glacier and extended two or three miles further than they now do. Rendu and Carroll glaciers have suffered decided recessions since 1896 (*John Muir*).

A comparison of photographs taken by Mr. Gilbert in 1899, with others taken by the author in 1892, shows that in that

¹The Harriman Alaska Expedition, by Henry Gannett, *Nat. Geog. Mag.*, 1899, Vol. X, pp. 507-512; and *Bull. Amer. Geograph. Soc.*, 1899, Vol. XXXI, pp. 345-355.

interval, the Grand Pacific glacier has retreated 500 to 600 yards; and the Hugh Miller 300 to 400 yards; the tide-water end of the Charpentier has receded nearly a mile and the Alpine end is now a mass of disconnected dead ice.

The records of Muir glacier are increasing. We know approximately its extent in 1880 from Professor Muir; and in 1886 from photographs by Professor Wright; and accurately in 1890 and 1892 from surveys by the author; pretty well in 1894 from photographs by La Roche of Seattle, and accurately again in 1899 from surveys by Mr. Gannett. With the exception of a slight advance between 1890 and 1892 the glacier has been pretty steadily receding. At present its extreme point in the middle of the inlet is not much behind its position eight or ten years ago, but the sides have receded fully half a mile. Morse glacier, a tributary on the west, became entirely separated from Muir glacier between 1892 and 1894 and continues to get shorter. Dirt glacier will probably also be an independent glacier before long.

Mr. Otto J. Klotz, of the Canadian Topographical Survey, concludes from a comparison of Vancouver's description of Taylor Bay with its present extent, that the Brady glacier in 1794 was at least five miles shorter than in 1893, when the Canadian survey was made, and that at the earlier date the glacier ended in tide-water. At present its end rests on gravels and does not quite reach the sea. These gravels must then have been laid down in the interval. He also concludes from Vancouver's descriptions and that of Sir George Simpson regarding Stephens' passage in 1841, that all the glaciers south of Fairweather Range have been steadily retreating in the last century. This, however, does not preclude temporary advances of individual glaciers, such as the Patterson, which, according to the *Pacific Coast Pilot* of 1891, was advancing and destroying trees at that time. The Le Conte glacier is at the head of a fiord about six miles long, and has retreated about half a mile between 1887, when the United States Coast and Geodetic Survey chart was made, and 1893, the time of the Canadian survey. A

description of this region by Vancouver does not give any reference to this fiord. It is therefore probable that it was entirely filled with ice a hundred years ago, which would indicate a retreat of Le Conte glacier of six miles in a century.¹

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¹Notes on Glaciers of Southeastern Alaska and Adjoining Territory, by OTTO J. KLOTZ: *Geog. Jour.*, 1899, Vol. XIV, pp. 523-534.